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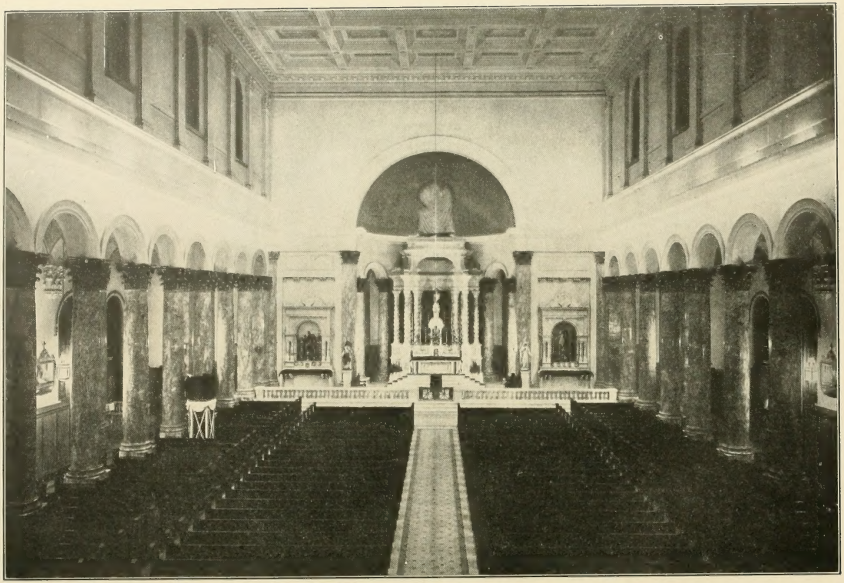

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HISTORY, DEVELOPMENT AND EXTENSION OF THE ELECTROMAGNETIC SPECTRUM

By DR. H. P. HOLLNAGEL, PH.D., Dept. of Physics, M. I. T.

III.

IN our last article we were occupied with those electro magnetic effects which in every-day life are designated as visible: In that which is to follow the eye no longer directly determines results. To maintain that all investigations of an optical character should be based solely upon the present form of eye as the "Ultima Thule" in apparatus would be a grave error. May we not hope—or at least conceive of a system of experimentation in which the sense of touch has been so well developed that it may satisfy our every need in this respect? Assuming present knowledge, with proper psychological conditions, is not an "infra red or ultra violet eye" a possibility of the future? Helmholtz early showed that such might be possible by his own observations in the extreme violet. How much simpler would experimentation then be! Unfortunately, mankind in its process of evolution lacked the modern tendencies to influence it, hence has had to devise and design new methods and apparatus with every advance into the unknown.

At the risk of considerable tedium we shall have to refer continually, as we proceed to such as have made possible the advance of spectroscopic knowledge in those regions where, ordinarily, we could have but groped in the dark.

Some hundred years after the Newtonian announcement the contemporary scientists—Landriani, Rochon and Senebier—were interested in the measurement of the maximum heating effect of the visual rays. They had variously placed it in the yellow and orange-yellow with great indefiniteness.

Sir John Leslie (1766–1832) attempted, photometric devices to establish the result but eventually contented himself with exploring only the visible regions. When, in 1800, Sir Fredrich Wilhelm Herschel (1738–1822), declared the maximum heating effect to lie outside the visual red, he was severely criticised. The aforementioned had made use of a differential air thermometer—simply a glass U-tube containing alcohol, or some light liquid, the motion of which could be observed as the result of the differential expansion of the air in the two bulbs sealed on either end. One of these, blackened, was placed at the focus of a concave mirror upon which the radiant energy was incident—the other being maintained at room temperature.

In Herschel's work the very simple procedure of passing the blackened bulb of a mercury thermometer through

the various parts of the spectrum led him by chance to carry it beyond the visible region. In thus digressing from his main object he was directed to the great discovery—as is so often the case. The purpose in this investigation, had been the choice of a proper sun-glass for his telescope.

Following closely upon his heels Englefield, utilizing a lens to better conditions, reproduced and substantiated Herschel's results causing Pierre Prevost (1751–1839), to join in a polemic against them. Biot and others followed but Berard favored Herschel's views and later Prevost satisfied himself as to their correctness.

No new developments were recorded until 1818 when Johann Seebeck (1770–1831), using an air thermometer of increased sensibility explored the spectrum with great care. His first noteworthy achievement was the demonstration of the dependence of the position of maximum heating effect upon the dispersing prism, i.e. a flint glass gave quite a different location from that obtainable from a piece of crown otherwise similar in every respect. Second only to this was his assertion that atmospheric conditions had a similar effect, i.e. a misty or clouded sky would shift the maximum intensity from the infra to the visible red or yellow. The result of his investigation caused him to conclude: There are no heat waves in the sense that Herschel alluded to them, but color exists no matter how feeble in intensity, outside the red at least to this maximum if not beyond it.

Compare if you will the extreme viewpoint of the Frenchman, J. B. Biot, (1774–1862), announced in 1813 during the polemic against Herschel, Englefield and others with that of the Englishman, David Brewster (1781–1868), published in 1832. The former insisted that chemical effects (just discovered) heat and visible effects were but various manifestations of one type of radiation, though the rays themselves might be different in their properties, i.e., refraction, dispersion, etc. Sir David, however, believed there were no rays outside the visible, declared he had seen beyond the arbitrary limit of it and required a particular heat and chemical ray to explain the effects of that region. Combined with the fact that every color, according to his theory, consisted of three component rays, five distinct radiations were required to produce all the effects descriptive of a visible ray.

From one extreme to the other there was great diversity of hypotheses with as many advocates. The one having the greater element of present day belief therein was that of Biot.

Further progress depended virtually upon the improvement in apparatus. Fortunately this was at hand in 1823 when Seebeck discovered that an electromotive force comes into existence at the common junction of two dissimilar metals when heated; that this force was dependent upon the difference of temperature existing between the other terminals of the metals and the common junction as well as upon the character of the metals themselves.

It was the great service of Macedonio Melloni (1798–1854), to have adapted this to the advantage of science in the construction of the first thermopile—an instrument consisting of several minute strips of Antimony and Bismuth so arranged in series as to permit of one set of junctions being radiated while the others could be maintained at room temperature.

A large number of very fruitful results were obtained as a consequence. Among others the satisfactory demon-

stration of the reflection, refraction, absorption, and transmission of infra-red rays in accordance with the ordinary laws of optics. In fact, he also expressed the belief that certain substances had "heat color" while others were "heat colorless." From this, one inferred that certain substances have characteristic or selective absorption and reflection properties while others are perfectly transparent to the rays. In substantiation of the latter he early demonstrated the transparency of rock salt and flourite and seemed to feel that lampblack was a total absorber for rays of all wave lengths (this we know to be false as it has a finite reflection co-efficient). It is readily understood why Melloni insisted light and heat rays were identical in character.

Meanwhile, 1836–1840, J. D. Forbes proved that these radiations were polarizable, while Fizeau and Foucault succeeded by means of double refraction and diffraction in establishing interference phenomena. The latter established the presence of a Fraunhofer line at 1.445μ ($1\text{-}10\mu^{-3}$mms.) and the limit of the heat spectrum as 1.94μ. It may be worth mentioning that Sir J. F. W. Herschel (1792–1871) son of the great astronomer, believed he had isolated several Fraunhofer lines but as neither Lord Rayleigh (1842–), nor J. W. Draper (1811–1882), could reproduce his results with improved conditions it is reasonable to suppose sources of error as the basis of them.

In 1859 J. Tyndall (1820–1893) by using a ray filter—a cell filled with a saturated solution of iodine in carbon bi-sulphide—isolated a large portion of the heat radiation. Placing a thin platinum disc in the focus of a large concave mirror upon which the transmitted rays were incident he succeeded in heating it to redness. Later he made absorption measurements on gases using the thermopile of Melloni as a receiving instrument.

A most interesting and startling experiment was next announced by Sir William Crookes (1832–) in a paper entitled "The Repulsion of Radiation." By the means of the first radiometer or "light mill" it was possible to show a constant increase of energy in passing from the extreme infra red to the shorter wave lengths of that region whence a regular decrease into the violet was noted. This instrument in its elements is a vane of minimal weight coated with lampblack and so counterpoised in a proper vacuum that it may rotate freely about a vertical axis. When light falls upon such a vane it is repelled an amount which is proportional to the energy which impinges upon it.

About this time W de W. Abney succeeded in photographing the invisible region of the spectrum as far as 20,000 Å. i.e. 2μ. Two years later E. Pringsheim fixed the limit of the same region as 15μ, having used an instrument of the Crookes type modified in form.

During these later years an American, S. P. Langley (1834–1906) had been carefully preparing an instrument which he later misnamed, perhaps, the Actinic balance. In 1881 and the years following he improved and bettered it to such an extent that it was the most sensitive instrument known for its time.

To-day we refer to this instrument as the bolometer. Its essential features were two pieces of very thin platinum foil (.002mm), coated with lampblack; each of which was placed in one arm of the ordinary Wheatstone bridge arrangement. When balance was obtained each arm had identical resistance. If now radiant energy were allowed to fall upon either of these a deflection of the

galvonometer resulted giving a measure of the energy.

Allowing the sun's rays to fall upon a concave mirror they were focused upon a slit which in turn was in the focal plane of a similar mirror; a collimated beam was thus caused to fall upon the face of a rock salt prism which after refraction was condensed upon the surface of the bolometer. The beam was maintained constant in its position by a heliostat. This has an optical system arranged in such a manner that when its axis is properly placed with reference to the Meridianal plane, it will follow the sun precisely. A photographic means for automatically recording the deflections of the galvonometer was provided while simultaneously rotation the prism was effected. In this manner the entire energy distribution of the solar spectrum visible as well as invisible, was traced. He actually mapped seven hundred lines in the invisible region extending from the Fraunhofer A line to 5.5μ which he placed as the extreme limit.

In his later work the platinum strip was made of such dimensions as to warrant it being called a linear bolometer. In 1893, Heinrich Rubens collaborating with W. B. Snow in Berlin and Dr. L. C. H. F. Paschen independently utilized a similar instrument for investigating the unknown region. The former investigator successfully traced the transmissions of glass to about 3μ and fluorite ($CaFl_2$) to about 9μ. Mellioni, Knoblauch and Magnus had previously noted the great transparency of rock salt and sylvite for these rays, but it was Rubens who placed the quantitative seal upon their work. The limits of transmission according to the latter are 20 and 23μ, respectively. Furthermore the transparency of Carbon bi-sulphide solution of iodine was fixed at 4μ and that of water at 1.4μ. Practically the same apparatus as that of Prof. Langley was utilized though from this time the sun ceased to be the useful source of radiant energy for this type of investigation. Again Rubens instituted concave mirrors for lenses wherever possible. Only in later work did he use gratings solely; for as is well known Langley used grating and prism combined.

Rapid progression was most apparent as the spectrum was being extended. However, 1893–1896, were years of very careful study. Rubens and his colleagues were investigating the variation of the index of refraction with wave length most assiduously. It was at the close of this period that Prof. E. F. Nichols, now of Yale University, while engaged in a study of similar character discovered the very important property which quartz exhibits for waves of about 9μ length. By means of a radiometer of an improved type which he had constructed, Nichols demonstrated a seventy-five per cent reflectivity of quartz for these rays. This indicated that the long rays were practically reflected as though from a metal surface.

With his ever keen insight into affairs physical Rubens suggested the reflection of radiant energy on several such surfaces. On making the attempt sufficient energy was obtained to warrant measurements being made. A grating was constructed of wire 0.186 mms. in diameter in a manner similar to the old Fraunhofer type. Placing this in the path and studying the defracted beam, three reflection maxima were discovered at 8.05μ, 9.02μ and 20.75μ respectively. As these rays are, those remaining after all else has been absorbed or diffusely reflected away they decided to call them the "Reststrahlen" or "residual rays." Following directly

upon this they determined the index of refraction of rock salt and sylvite for these rays and established their electromagnetic character.

With the close of the 19th century came the development of the linear thermopile. Choosing copper and constantin of about 3–4μ diameter, Rubens and Aschinass, in 1898, joined in series a large number of these junctions. They were so arranged as to have their radiated surfaces in so narrow an area that the incident energy could be utilized to the maximum advantage. In combination with a sensitive galvanometer this instrument is credited with the detection of a temperature difference of 10^{-6} degrees centigrade. By means of it they were enabled to determine the very long heat rays isolated by successive reflection on rock salt or sylvite. Here again the aforementioned infra-red spectrometer, this time with but the grating, was used in the wave length determination, i.e. 52μ and 61μ, respectively.

In the interim between Nichols' work and the last mentioned, H. Rubens independently had shown that the residual rays of fluorite could be refracted through quartz prism of 10°. In conjunction with Dubois he demonstrated the possibility of the polarization of the Residual rays of rock salt and sylvite. In collaboration with Hagen of the Technische Reichsanstalt a very interesting relation between the electrical conductivity, wave length and reflectivity for such waves was established, thus again demonstrating the electromagnetic character of radiant energy.

It appeared from the observations on quartz that the longer the wave the greater the transparency. As a result in 1908–09 Rubens and Hollnagel undertook the construction of a quartz interferometer with which they redetermined the wave lengths of Restrahlen of rock salt and sylvite. As the results were in fair agreement with those previously obtained it seemed desirable to seek new fields with the satisfactory outcome of two new residual groups, i.e. those of potassium bromide 82.3μ and potassium iodide 96.4μ. The improvement of the Radiomicrometer in addition to the new method utilized made this possible. The Radiomicrometer is a very simple device essentially a galvanometer with a thermoelement included in the moving coil, which is delicately suspended in a concentrated magnetic field. Radiation falling upon this thermoelement causes a current to flow through the circuit which adjusts itself in accordance with the simple laws of electrodynamics. Deflections being noted by a mirror attached to suspension, were proportional to the energy received, which is in turn dependent upon the distance between inferometer plates. As previously intimated the source of energy in all these measurements was no longer the sun but either a Zircm, or Welsbach burner, Pintesh light or mercury vapor lamp.

Selectivity seems to have been the characteristic feature through all this advance. Indeed in the greater advances to come it is still more pronounced. The highly selective properties of quartz had been recognized, consequently when Robert Wood of John Hopkins and the Berlin Physicist set about to isolate a long radiation by selective refraction of quartz the world was not surprised at the announced result of 109μ. Two quartz lenses were so placed that an invert Pintsch burner in the focus of one formed an image at its conjugate. This was the source focus for the other which concentrated the radiant energy upon the thermoelement of the radiomicrometer

Using the interferometer previously alluded to and screening off the undesirable radiation they proceeded in the regular way to determine the wave length.

In the greatest achievement along this line this keen investigator was associated with the equally able physicist Otto von Baeyer of Berlin. Utilizing practically the identical apparatus, but inserting 17.5 cms. of transparent quartz crystalin the optical path these men satisfied themselves of the existence of a long wave in the quartz mercury vapor lamp. Ultimately using a black cardboard heat ray filter they measured its wave length by means of the interferometer placing it at 314μ, a magnitude easily seen with the naked eye 0.3mms. This is truly marvellous when it is known that every radiation measured to date satisfies electromagnetic requirements. Even the Zeeman and Kerr effects have been shown to be true for the shorter heat waves.

To be Continued.

AN ASSYRIAN PROPHECY OF THE NEW TECHNOLOGY

By A. F. BRIDGEMAN, M. I. T. '84

WHEN the famed English archeologist, Layard, in the 40's of the last century, unearthed the magnificent palace of the Assyrian king, Ashur-nasir-pal, at Kalah on the Tigris he found amongst a number of exquisitely carved alabaster tablets, a slab of finest grained porphyry whereon was writ in golden letters a prophecy, of evident import and weight. The prophecy related to the establishment of a School—a School through whose influence the country which it graced would have a marvelous development in wealth and power, a School which would be the means of bringing to mankind's service the treasures of the earth, the mysteries of the heavens above the earth, and the secrets of the seas beneath the earth. The tablet is reproduced below.

The prophecy appears to have been made about the year 884 B.C. at which time the king, Ashur-nasir-pal, after bringing his kindgom to a complete state of preparedness, did the logical thing by proceeding to bring slaughter and misery to all the other nations in Western Asia. At the same time he appeared to cherish a strong desire to have the prophecy of the School fulfilled during his own reign, a desire which was never realized.

Two hundred years later another king, named Ashur-bani-pal, came to the Assyrian throne, and this monarch had a hankering for literature. He commanded his scribes to make copies of the annals of Assyria from the libraries of all the great cities of the land. Thus copies of the famous "School Prophecy," made on clay tablets, became distributed among the surrounding nations. The original was kept in a bronze case in the center of the library.

Yet in spite of the fact that Ashur-bani-pal was a most splendid monarch and his library the greatest of ancient times, he never had the gratification of seeing the great School on the banks of the Tigris. Nor did any other Assyrian, for in a few years the nation came to its downfall. However before the fall of Nineveh, a clay copy of the School Prophecy had been deposited in the library at Babylon, and Babylon's king, Nebuchadnezzar, famous alike in sacred and profane history, became so worked up over the School Prophecy, and spent so much time thinking about it, and dreaming about what a fine feature it would make on the banks of the Euphrates, just opposite his hanging gardens, that he lost his reason and had to be put out to pasture where he "ate grass like oxen." (For further details read Daniel IV, 4–37).

When, after seven years, both his reason and himself had returned to their thrones, nothing could induce him to think or speak of the School again.

After the handwriting on the wall, when the kingdom passed on to Cyrus and his Persians, the Prophecy of the School passed on with it.

Then came Alexander the Great, and

Babylon with its treasures, among them the clay tablet and its Prophecy, fell into his hands and was carried to Athens. Surely now will the prophecy be fulfilled, for where in all the world is there a love of learning like that of the Greeks? Yet, strange to say, no school in all Greece ever so much as approached the heights the Assyrian Prophet had in his vision seen and foretold. When, about 200 B.C., the Roman legion met the Greek phalanx on the plains of Thessaly, and Greek supremacy passed forever, the Prophecy passed with it and became a heritage of Rome.

Rome wanted that School, wanted it like a cat wants a kitten, and a town meeting was held to consider the question. Lucullus, the consul, who, after leading the Roman armies to many a victory, had settled down to farming and had achieved the distinction of bringing the first cherry tree into Europe, insisted that the School should specialize in agriculture. Crassus, who owned Rome's fire department, urged that the School have a department of fire insurance. Neither of these plans were favored by the meeting, which adjourned for one week without taking action. Before the week had expired, war was declared against the Parthians, and Crassus took the field against them. The campaign was disastrous to the Romans. Crassus, who was to finance the School, was killed and the whole scheme fell through.

Other centuries passed, and not until the time of Constantine did the Romans again think of of embodying the prophecy of the wonderful School. When the emperor had put Constantinople on its feet, he called the attention of the Senate to the fact that such an institution of learning as had been foretold by the Assyrian seer would be a great asset to the newly founded Eastern Empire. The committee on schools in the Senate called the Emperor's attention to those words in the prophecy which said that The School would be located on the banks of a river. While the Bosphorus was a long and narrow stretch of water, it could by no stretch of the imagination be called a river. The whole plan was therefore killed in the committee.

So time went on. New nations grew out of the wreck of the Roman Empire and finally America was settled and Yale and Harvard were founded and grew into mighty universities. Surely one or the other of these beneficent seats of learning would fulfill the requirements of the ancient inspired one. But no—Yale is situated in the heart of a city and *near no river*. This eliminated Yale. As for Harvard, her buildings run to red, while the specifications of the prophecy call for "the gray of dawn."

In the year 1864, a company of men, profoundly interested in the founding of a school which should add to the happiness of human life, be influential in developing the resources of our country, and help to make for the health and comfort of its people, met to talk over the matter.

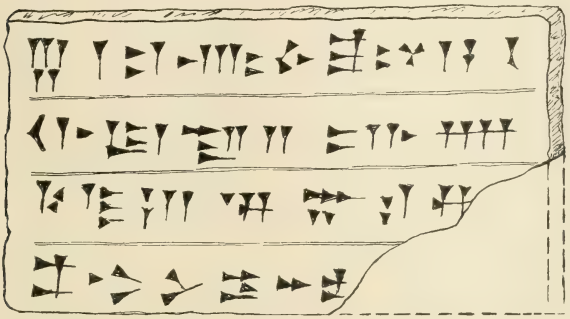
Some of these men knew of the old Assyrian Prophecy, having seen a copy of it in the Louvre at Paris, and they hoped to see the fulfilment of it in the institution they were planning. But while it seemed practicable to comply with most of the requirements of the tablet, no suitable site for the School could be found on the banks of any river.

They therefore decided to found the Institute of Technology, locate it on the Back Bay and let it stand or fall on its own merits, without the moral support which a location on the prophesied river bank would have given.

Within the past few years, however, a new Technology has been evolved from the old. *Its buildings are on the banks of a river, they face the mid-day sun and they are the gray color of the dawn.*

* * * * * * *

One evening, last Spring, when the class of '84 held a reunion, one of the members raised the question whether the New Technology might not fulfill



TRANSLATION: In a day (or which many will look, shall arise that which by its (ea hing will make the nation possessing it a nation of power; and its people a happy people.

It shall make the earth bring forth that which was hidden and shall tie together the ends thereof, and shall adorn it with structures pleasing to the eye and serviceable to man.

Gray as the dawn shall be its color and it shall face the mid-day sun on the banks of a river called (tablet broken) the name thereof shall be (tablet broken).

in all its requirements the old Assyrian Prophecy. Attention was called to the article on Assyria in the February, 1916 number of the Geographical Magazine and many thought that the prophecy would be fulfilled when the great higira was made in June. The discussion waxed warm and about 11.30 a brief recess was taken, following which the class secretary said that while he regretted not being able to demonstrate his impressions mathematically, he was firmly of the belief that the New Technology was the School referred to in the prophecy. In view of this probable fact it was moved that Ashur-nasir-pal, the Assyrian king who ruled in 884 B.C. (the date of the Prophecy) be made an honorary member of the class of '84; and although some of the class thought that on account of his bloody record he ought not to be admitted, the majority agreed that his record might not be worse than that of some of the class, and that while 884 B.C. was a long way from 1884 A.D., it was '84 anyway, and what of the difference. So he was voted in with all privileges.

Just after the vote was taken the clock began to strike twelve, and a strange thing happened. Over in one of the large easy chairs which had not been occupied appeared the form of the newly elected member of the class of '84, rather misty to be sure, but Ashur-nasir-pal, the old boy himself, without a

doubt, looking for all the world like one of those Assyrian chaps whose square muscular forms and long beards may be seen in the Archaeological Department of the Art Museum. Ashur-nasir-pal was followed by the shadowy form of Nebuchadnezzar, chewing a bunch of grass, and after him came Alexander the Great. Soon all of the vacant chairs were filled. Lucullus, holding a little cherry tree; Crassus with a fireman's trumpet, Constantine carrying a cross, and many others who had hoped to see The School in their day. Finally, a tall, dignified form appeared, at the sight of which every one rose and stood in an attitude of reverence and love, for in some manner the presence of the Institute's first president was felt by all. As the clock finished striking the hour of midnight a voice was heard which said: "This is The School"; and as the shadowey forms began to disappear the voice again, in a language which was a composite of Assyrian and Babylon, Persian and Greek, Roman, and many other tongues, yet easily comprehensible to all, spoke these words: "THE PROPHECY HAS BEEN FULFILLED."

THE SPREAD OF LIGHT

By FREDERIC NEWLIN PRICE, Swarthmore, '05

III. COMMERCIAL

DO you recall Riley's poem "Out to Old Aunt Mary's" and that line—

"Then in the Dust
Of the Road again with sunshine spread
As thick as butter on country bread."

Well, sometimes I find offices and churches and schools where light is spread in just big chunks here and there. It may be decorative, it is not efficient. More and more engineers are believing in the "Spread of Light." It may be called diffusion or distribution, it will be successful if we throw the rays evenly on the working plane.

For offices it has long been the practice to equip a drop cord, install a desk lamp and stop. This will not now do, for we have come to realize that for the man at the desk to stare into the blaze of 10 to 18 fc and often look up into utter darkness, is criminal negligence to the human eye. Each turn of the head means contraction or expansion of the iris and alternate strain. Many remedies present themselves—we can equip the office with general illumination and brighten the upper areas. We may remove the local light and create a bright cheerful room full of light directed into each corner. With these two principles in mind design and instrument may be selected to harmonize with the architecture so as to be unnoticeable. We insist that the light must be natural and not spectacular, for the eye will see the brighter spot. As you enter a room your eye automatically selects the bright spot just as the tongue automatically finds the hole in your tooth, or just as your personality selects a cheerful person in a crowd.

When we consider churches it is our conviction that the light must be spread from an enclosed source. It may be a source entirely concealed and one directing the light evenly against light colored surfaces that in turn redirect and diffuse the illumination throughout the room. It may be an inclosed unit that shields the bright filament of the lamps and sends the light filtering through an etched or opal plate, the intrinsic brilliance of which is not spectacular. In this way we create the feeling of light and restful conditions of attention and meditation.

On the other hand hotels and cafes require spectacular or stimulating light, for here people must talk and dance and be entertained. The bright alabaster bowls handsomely hung, find favor in the habitue of Broadway. Great variety is the vogue—parchments, silks, colors, candelabra—all come in for decorative effects. Nevertheless, if the work is well done you will find that the doctrine of the Spread of Light is strictly adhered to and the decorative spots of light added afterwards.

If you would consider study-room lighting look around you, for very careful engineering was done in lighting Technology. Here a dense opal urn was employed to cut the brilliance of the

MENGER HOTEL, SAN ANTONIO, TEXAS
3486 Alba Bowls are used in lighting this hotel

A GOOD EXAMPLE OF THE SPREAD OF LIGHT
Coliseum Theatre, Seattle, Wash.

unit and to diffuse the light over the ceiling. The light and the ceiling are approximately the same color. The intensities here and there are closely the same. The result is a feeling of comfort and ease in sight and mind.

It is interesting to note that the United States Government Treasury Department standardizes on the same unit of dense opal and diffused light from a semi-opaque source. As each individual varies in all respects so the eye is different in us all—to some a bright light source stimulates, others it oppresses. So in this installation there is again the safe golden mean of the ancients, to give good spread of light—allowing some 20 per cent over your figured calculation for dissipation in refraction coefficient of the unit or surroundings.

You may let your artistic impulse free on the consulting offices and the stores and meeting rooms, foyers, etc., for here little exacting work will be done and your lighting system should not only give good uniformity and intensity and diffusion and cheerfulness, but must also give a feeling of welcome hospitality. Shadows no longer are a menace. The eye must be flattered, and need not be so carefully protected—for the lighting wall brackets and hanging lanterns offer good results.

While each case is more or less individual commercial lighting is much the same and we need only keep in mind the Spread of Light to accomplish a most beneficial benefaction to those who have work to do.

PERSONAL EFFICIENCY

By ROBERT L. TURNER, M. I. T. '20

Editor's Note: "The Technology Monthly Engineering Journal" is trying to print in its columns more articles by the undergraduates. We hope that the future will bring many more communications and suggestions.

Below is printed some of the ideas of one of the class of '20. Personal Efficiency gives food for thought and is written in a very commendable manner.

PERSONAL efficiency, that quality coveted by every one, is literally, the power of producing the thing intended. To attain any degree of efficiency, the structure upon which we build must be firmly founded on the fundamentals, which are acquired only by our individual application.

But what are these fundamentals? Probably the most important is the power of Observation, which works hand in hand with Memory. As infants we come to know persons, and things by their appearance; later on we are able to call them by name, provided the memory is able to retain them. Becoming older the powers of observation and memory increase as they are exercised. We are sent to school and there learn our letters by seeing and memorizing. Gradually we attain the ability to read and become proficient in it. This combines both speed and accuracy. From time to time we are called upon to relate some experience that we have had; this again taxes our powers of accurate observation and memory. As we are continually learning throughout our lives, it is of the utmost importance that we be able to follow instructions as they are given to us. The power to do as we are directed is probably of more importance to us than any other quality, for obedience and ability to do exactly as we are shown is the first virtue demanded by every instructor and employer.

However, if we do not go beyond acute observation and memory we are losing much, for the development of the mental faculties alone produces a one-sided efficiency. The keenness of our minds should be used to effect skill with our hands. Everyone at some time or other has need of the ability to use tools and the awkwardness of the situation will be relieved if he has had experience in their use. For example the work of the architect requires great skill in the manipulation of his drawing instruments, if any degree of accuracy and neatness is required. Our efficiency may also be affected by the dexterity with which we handle the laboratory apparatus or other pieces of mechanism where adroitness with the hands is required.

To be efficient we must be "on the job" at all times. This is possible only by always being in good health. To keep well a certain amount of regular recreation is required; mental as well as physical. Our individual desires choose for us the form of recreation in which we shall indulge.

One of the greatest factors in personal efficiency is the ability to get along with our fellow men. As has already been stated we learn much by observation, observing principally, those

round us. We see what they can do and unconsciously measure ourselves with the standard which they have set. For this we should be deeply indebted and try to repay it in some measure. It may be done by becoming the close friend of our companions. Friendship opens up a large field for further education. Our very speech requires thought and must be judged before uttering, lest we offend. Conversation with those older than ourselves has a broadening influence and is conducive to deep and serious thinking. Again, some of our friends or acquaintances may not be able to keep up a conversation, so there another phase of getting along with people is developed.

Disagreeable tasks are experienced by every one, but the way in which we emerge from them indicates our degree of self-control. Self-control is obtained by attention to the little things in life. If we form the habit of punctuality or develop the power of concentration, we have done much to gain it.

The qualities that we have been discussing: "Observation," "Training the hands," etc., are merely the means toward an end. The end is the profession we choose for our life work. Having selected our work we study in that direction increasing our ability by actual commercial work, wherever possible, and when we have finished our course in a technical school we are ready to take our place among the efficient men of the world.

RIFLE PRACTICE AS A PART OF PREPAREDNESS

By MAURICE F. BRANDT, M. I. T., '16

IN the course of the last two years a great deal has been written on the subject of National Preparedness, and our United States have gone into a preparedness program unparalelled, even comparatively, in our history; if in the world's records of nations at peace. It is not my idea to discuss this subject in general, nor to convince you of its wisdom—such would be a waste of time, as every right-thinking American must be in favor of it.

Much rests with the individual in the effectiveness of our Preparedness for War. It may be all right to say: "We will prepare for war, either for defense or offense, and adequately. We must do this to preserve our national existence." Further it is good to say to our representatives in the Congress: "Prepare for us an adequate army and navy, and have committees study the Swiss, French and German military systems." Thus far we as a nation have already gone. But we must go further, and *as individuals we must prepare.*

Compulsory military service for the purpose of training has been advocated, and while it would put us on a most excellent military basis, I am not sure that this is necessary. There can be no doubt, however, of the absolute necessity for us all to fit ourselves to be ready at a moment's notice if our country should need us. And by ready I mean prepared, not merely willing. There are many ways of doing this, and we should make ourselves *proficient* in as many of the things necessary for the successful prosecution of a war, as we can.

Rifle Practice is Preparedness Preparation not alone for aiming a rifle or field gun, since so many of its fundamental principles are also the basis of other parts of what should be every male's individual preparedness. If you have once properly mastered these basis ideas, you will then much more readily be able to make yourself proficient in other lines, on anyone of which our country's safety may at some crisis depend.

THE FUNDAMENTAL PRINCIPLES

Of these many fundamental principles that are common to many branches of Preparedness, including Rifle Practice, the principle one is health. The average American man probably considers himself as a living example of physical perfection! While I have not at present access to any statistics on the subject, I believe that such is far, very far from the actual fact. Hence, do everything you can that will develop yourself physically, including in this your eyes as well as your body. Good rifle shooting requires a good state of health. My rather limited experience proves this conclusively. Close observation has shown that the men in the best health, that keep the more regular hours and as nearly as possible go into athletic training, make the highest and most

regular scores. Possibly Track Squad work has a greater benefit in this *one* aspect, but rifle work is not small in it. The regular walk to the range combined with the tension while on the firing line (which is greater than on track or field), both are great health stimulants, which is the greatest *single* principle of preparedness.

"Anything that is worth doing is worth doing well," is an old but pertinently true axiom. So in work with the rifle, go into it thoroughly. This means exercises that will strengthen the muscles that are used in the work, notably the arms, shoulders, neck and legs. "Butt's Manual," which few fresh men really appreciate, is designed for this purpose. Few shooters are wise enough to take advantage of this, as well as other sitting-up exercises, which are ordinarily forgotten as soon as Major Cole and Frank Kanaly pass the men in their respective courses. Such exercises are the basis of training the English army as the most fit body of men in the world war, and which exercises a rifleman must respect if he be thorough in his training.

There is no form of exercise that trains a man's nerves and eyes to obedience so well as does rifle practice. Are not these two qualities essential in the transit-man of the Engineering Corps or the bacteriologist that examines the water and food supplies of the army? Of all the men that I have seen during four years' active association with the Institute Rifle Club (as a student), there has only been about one per cent. that have been sufficiently able to control their nerves to discharge the Springfield or Krag rifle without "flinching" sufficiently to spoil what is considered good shooting (at the start of their shooting careers). It takes a couple of years' use of the gun to get real control of the nerves of the finger, hand, arm, body and eye to aim the rifle, squeeze the trigger, and hold the piece steady, so as to be able to place each shot just where it is wanted, for even so short a time as it takes to fire a single "string" of twelve shots, not to mention an entire afternoon's shooting on the same range. This once accomplished, however, and the entire unison of mind, eyes and body is an accomplished fact, and it is a thing that can be used to advantage in anything that the fellow does.

Applying the principle of "Safety First" while handling guns, and on the range in particular, is a matter of life and death. Every man is responsible personally for his care, as well as seeing that no others make foolish and unintended errors. This highest responsibility is a good thing to get accustomed to, for responsibility is shunned by most men,—those that accept it and make a good try at "making good" are almost sure of success. Incidentally, there has never been an accident while handling rifles at Tech, as far as my knowledge goes.

It devolves upon the Captain of the Team, who is usually the most experienced shot in the Club, to make rules, which if enforced by the range officers, will insure the safety of all. This involves obedience on the part of the men taking part in rifle practice. For concerted action by the composite parts of a nation's arms, obedience must be absolute. It is a painful thing to learn, but essential to organization in any branch of a preparedness plan.

For the fortunate few the ability to make the Rifle Team (which receives the rTt for good work) prevents the greatest of opportunities. In addition to all of the above enumerated principles the Team offers the making

and study of an organization. The secret of the great General Joffre is that he has an *organization in fact* of the entire French Army. His army, both in the trenches and in the factories, forms the most effective unit that the war has produced. Working with other men, the group acting as a unit, helping the others and thereby gaining strength, is the hardest of things to accomplish. There is no better chance in your student life to get this general experience than by making the Rifle Team.

FACULTY HONORS

VI.

PROFESSOR EDWARD FURBER MILLER

THE incoming freshman at Technology in future years will look about him upon his arrival, and all amazement at the far flung reputation of Technology will be instantly stifled. What wonderful buildings, what extensive facilities, what limitless equipment, no wonder Tech leads the field of engineering schools! But those of us who have grown into this magnificent new dress know better. We know that the glory and name of Tech were as great in her shabby home across the river as they are now, we know that not the buildings have made Tech, but the men, the professors, the faculty. And in more ways than one. They have been not only teachers, but men of affairs, men of wide human understanding, men whose text-book lore was the least of what they gave to the students and the Institute.

Of these men is Professor Edward Furber Miller, in charge of the Department of Mechanical Engineering at the Institute. Technically, according to the catalogue, Professor Miller is Professor of Steam Engineering at Technology. That is his title to us. His titles in the outside world are so numerous as to be wearisome. But, whatever the titles it has bestowed upon him, he is known there and known well. For the engineering fraternity it would be enough to connect Professor Miller's name alone with the mechanical engineering course at any school to effectively put that school on the map.

Professor Miller's latest work, one of great importance in this day of phenomenal growth of refrigerating science, has been in the study, compiling, and standardizing of laws governing the operation of ammonia refrigeration machinery, similar in scope and importance to the recently completed work of standardizing, for the entire country, boiler rules and regulations. In the latter work Professor Miller's part was also of importance, as a member of the powerful committee which framed and put into effect these laws of far reaching engineering importance.

Professor Miller did not jump at once into the limelight of the engineering world. The course of his reputation has been one of steady growth from the time he began the task of preparing himself for his vocation (at the best fitted place in the world—Tech) until today. A graduate of the Institute in 1886, he was for two years an assistant in the Department of Mechanical Engineering, and for the following four years an instructor. In 1892 he became Assistant Professor, in 1899 Associate Professor, and in 1906 Professor.

To keep track of his manifold activities as an engineer is a job for a social secretary, rather than a mere outsider. In one year alone Professor Miller has been in requisition by a Massachusetts Commission in determining the constants of safety valves, a field in which he is considered a world authority; he has rendered service to the cities of

Lynn and Fall River in matters relating to pumping machinery; while for the Boston Water Department he has made tests on the crushing strength of pipes buried under varying conditions of depth. One matter of interest in his special work was his advice on a coal pocket and handling machinery for the Boston City Hospital, in which there resulted a saving to the municipality of thirty thousand dollars. As an expert he has been called in on all important law-suits concerning boilers and boiler explosions in Massachusetts.

It is evident from the above how fully justified was President Maclaurin's summing up of his activities in a report on the matter of service to the public by college professors. Professor Maclaurin said that he, Professor Miller, was a man who never lost sight of the practical world in spite of the responsibilities of his professional position.

The scope of Professor Miller's interests may to an extent be gauged by his affiliations. He is an honorary member of the National Association of Stationary Engineers, a life member of the Massachusetts Charitable Mechanic Association, a Fellow of the American Academy of Arts and Sciences, a member of the Boston Society of Civil Engineers, and of the National Association of Mechanical Engineers, a Director in the American Association of Refrigerating Engineers and Chairman of the Committee on Gases and Units.

Professor Miller's written works cover a wide field of subjects. Some of them have to do with the utilization of waste heat, observations on foreign technical schools, and on other engineering subjects. His book "Steam Boilers" was written in collaboration with Professor C. H. Peabody, and "Problems in Thermodynamics and Heat Engineering" with Professors C. W. Berry and J. Riley. He wrote also the section on "Steam Engine Indicators" in Crosby's "Practical Instructions."

THE ENGINEER AND NATIONAL DEFENSE

Editor's Note: The following is written by a man who has been active in the Army Engineering service. He is a man of ideas and one well worth listening to. That the college man is an important factor as an engineer in national defense is an undisputable fact. Technology as a whole has recognized this fact and has today an engineering corps which is one of the best equipped and is becoming one of the best trained engineering corps in the country.

CONGRESS at its coming session will discuss one of the most important problems that has arisen in recent years, that of so rearranging our general scheme of national defense as to make the duty—not to say privilege—of defending our homes and country in time of stress encumbent upon every citizen of a certain age.

The framers of the Constitution, fearing that this country might be embued with the spirit of militarism which had overrun Europe and contributed to her constant turmoil and that through such means the liberties for which they had made so many sacrifices might be lost, wrote into the Constitution measures which they considered were adequate to defeat any such possibility; but also clearly specified that it was the duty of every citizen of specified age to be trained in the use of arms so that he might be qualified to bear them in times of stress.

These acts produced what has from that time been known as the "Militia," and in most states this has been divided into the active Militia—undergoing training at regular periods throughout the year and obligated for a period of such training—and the reserve Militia, which embraces those of military age but who are in no way obligated other than as provided in the Constitution.

Accordingly, in every time of stress in this country those who were the first to feel the burden of the heavy hand of war were the ones who had, from a sense of patriotism or for other reasons, offered themselves as volunteers for training in the active Militia. From the loose system of the olden days in which the troops appeared only for the Fall or Spring training and were under arms but a single day, there has gradually evolved a system of training—through the enactment of a series of laws—which has raised the militia of the country, on an average, to a very high state of efficiency and requires the sacrifice of a large amount of time on the part of both officers and men in study and actual practice in manœuvre.

The recent service of the National Guards on the Mexican border has very forcibly brought a realization to those who saw such service, at so much sacrifice to themselves and their families, that this duty was being performed largely at their expense and for the benefit of those who had so lightly treated this obligation that they had not even undertaken to understand the rudiments of military training.

The great injustice of asking men of affairs to abandon their homes and families, to sacrifice their business for any fancied cause that a government official may deem is necessary ground, is destined to rest heavily on the con-

science of the American people and there can be but little doubt but that the year 1917 will see a complete revolution in our military system, wherein there will be some approach to an universal recognition of the obligation incumbent upon every citizen to be qualified to defend his home.

At the present time in our army organization there is a great need of men with technical training. Even in Massachusetts, where the militia has reached a very high standard of efficiency, there is only a skeleton organization of engineering troops, and it is probable that in the immediate future there will be a great change in the recognition paid to this important branch of the service. Having to do as it does with those things which are of vital importance in the progress and success of armies in the field, the rebuilding of bridges, the spanning of rivers, the repairing of roads, all require men of technical knowledge and experience. It is probable that in no other branch of military service is the opportunity for the exercise of initiative and personal ingenuity so great. Most of the apparatus employed is susceptible to great improvement and the opportunity extended to young men of the technical schools is greater than almost any other field.

Already some of the technical schools and colleges have recognized the opportunities that exist in this branch of the service, and there can be but little doubt but that there will be a more ready appreciation of them in the immediate future, for upon the manner in which the problems presented are grasped and solved depends our future as a nation.

THE SHIP-TOOL SHOP OF THE FORE RIVER SHIP BUILDING CORPORATION

WHAT is claimed to be the largest manufacturing shop of its kind in the world has recently been completed at the yard of the Fore River Shipbuilding Corporation of Quincy. It is a huge structure standing close to its slips and is visible for miles. It is so lofty that from the galleries at either end the busy workmen below look like pigmies and the space is so vast that even the deafening clamor of the machinery is subdued.

It is known as the ship-tool shop. It is about 750 feet long, 185 feet wide, and 60 feet high with a flooring of concrete and bitulithic. It is constructed of red brick imposed upon a steel frame and reflector glass is used in such prodigality that the center of the building is as well lighted as any portion of it.

It is in this shop that the steel which goes into the vessels in process of construction is worked. A number of giant cranes slip noiselessly along its length overhead picking up tons of steel from the cars which are run in from the railroad track outside. Indeed, everything is handled by the cranes which vary in their lifting capacity.

Each plate of steel has its appointed destiny but it has to be manipulated according to hieroglyphics recorded on its face. Here, it is mercilessly punched with holes to accommodate the rivets. There, it is treated by a massive hydraulic press to curve it according to the draughtsman's design, for many plates must be curved to find a place in the frame of a steel constructed vessel. These hydraulic presses gently caress the plate and this process is practically the only noiseless operation on the floor area of the shop.

A large portion of the floor space is devoted to the oil-burning furnaces where both plates and bars of all the shapes are demanded of them.

Another remarkable feature of the shop is that it has its own railroad encircling the entire area, run by storage battery. It runs out of the building to the various slips and is used for conveying the finished material to the ships under construction.

In the center is what looks like an exaggerated telephone booth with its scores of cables spreading off in all directions. It is the switchboard room wherein is controlled the electricity which furnished both power and artificial light.

The rooms adjoining the galleries at either end, tucked into the trusses, are chiefly devoted to the offices of the general superintendent, foremen, inspectors and draughtsmen. On the floor undereath exceptional space is devoted to the workmen's quarters. Each has his own individual steel locker and beside the lockers are toilets, and shower baths and wash-stands supplied with hot and cold water in charge of an attendant.

Away up near the roof is a space comprising almost the entire area of the structure devoted to the mold-loft. Here every part of every vessel under construction, be it a super-dreadnaught or a tiny tug-boat, is drawn flat on the

pine floor in full size. From this drawing, full-sized patterns down to the smallest rivet-hole are made to be sent below to be reproduced in steel. No shop in any shipbuilding yard in the world has so spacious a loft. A portion of this floor is devoted to the steel-metal shop where galvanized iron, which plays so large a part in ship furnishing, is turned out.

Safety First! is the slogan of the shop and a huge sign with letters nine feet high is a continual reminder for the exercise of care, so that both life and limb may be conserved. Every pin, gear or moving part is encased in protectors. No weight is lifted by manual strength for the cranes are always available and conveniently located. Indeed, except for guiding purposes, the steel is not touched by hand from the time it leaves the rolling mills at Bethlehem till it finds its place in the structure of the ship.

HARVARD ENGINEERING SOCIETY OF NEW YORK

THE Tenth Annual Dinner of the Harvard Engineering Society of New York was held Thursday evening, December 7th, at the Harvard Club. One hundred fifteen members and guests were present. Charles Gilman '04, President of the Society, was toastmaster. The other speakers were: President, A. Lawrence Lowell; Ira N. Hollis, A.M. (Hon.) '99, President of the Worcester Polytechnic Institute; W. S. Keis, Vice President of the American International Corporation; Charles H. Mapes, Chairman of the Athletic Committee of Columbia University and Member of Football Rules Committee and L. F. Loree, President of the Delaware & Hudson Railroad.

Mr. Loree told of the workings of the railroads and of the Interstate Commerce Commission, outlining the difficulties with which the railroads in particular had to contend with in carrying out the valuation work. Mr. Kies discussed the position of the United States in the commercial world with particular reference to the conditions which would prevail at the conclusion of the European War. President Hollis gave a talk on the service which could be rendered the country by its college graduates in other fields than military service. Mr. Mapes spoke interestingly of football with particular reference to the 20 to 0 victory of Harvard over Yale in 1912. Professor Lowell reviewed the Harvard Technology Merger, explaining its financial aspects and the relation of the Faculties of the two schools.

Besides the speakers mentioned there were present:

R. H. Howes, President of the Technology Club; L. D. Gardner, Secretary of the Technology Club; D. Q. Brown, President of the Princeton Engineering Association; C. H. Higgins, Secretary of the Princeton Engineering Association; R. T. Dana, Secretary of the Yale Engineering Association and C. N. Green, President of the Cornell Engineering Society; and the following members of the Society, with their guests: H. J. Alexander, '00; F. H. Beall, '13; J. H. Betton, '71; J. Binda. '10; J. E. Bunting, '98; W. H. Burr, honorary member; T. Crimmins, '00: F. H. Davol, '03; T. C. Desmond, '08; C. R. Dodge, '06; G. E. Doyen, '07: C. D. Drew, '97; A. Durant, '03; D. G. Edwards, '03; K. B. Emerson, '02; R. B. Emmons, '06; J. H. Fedeler, '97; F. R. Fitzpatrick, '03; A. D. Flinn, '02; R. S. Foss, '03; A. H. Fox, '03; H. H. Fox, '00; C. Gilman, '04; H. Goldmark, '78; J. F. Gowen, '11; R. W. Greenlaw, '02; W. McK. Griffin, '05; H. M. Heal, '04; W. L. Hanavan, '03; W. L. Harrington, '98; F. W. Harvey, '13: J. R. Healy, '97; C. M. Holland, '05: H. W. Horne, '94; D. W. Howes, '03: A. C. Jackson, '88; S. J. Jennings, '85: A. L. Kimball, '14; J. M. Levine, '06: M. F. McAlpin, '97; J. R. MacArthur, '85; J. F. Manning, '03; F. Mason, '96: E. W. Mills, '02; E. Q. Moses, '02; P. Mulock, '03; G. Newell, '98; F. M. Newton, '98; W. K. Page, '10; C. P. Perin, '83; J. P. H. Perry, '03; F. Pope,

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EDITORIAL SECTION

The Technology Monthly
Engineering Journal

A MAGAZINE DEVOTED TO THE INTERESTS OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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All manuscripts submitted for publication in the TECHNOLOGY MONTHLY ENGINEERING JOURNAL should be accompanied by the writer's full name and address. Manuscripts not accepted for publication will be returned only if the author so requests. Photographs, drawings, etc., will be returned to the contributor immediately after publication.

Forms close the 28th of the month immediately preceding date of publication. Material specially arranged for may be received up to the fifth day following.

EDITORIAL

TECHNOLOGY'S NEED

IN our November issue, under the caption "A Tradition Laboratory" we urged intelligent, organized effort on the part of Institute organizations toward the establishment at the new Tech of those customs and traditions which in the future would be as helpful and inspiring to the student body as those which, precious but all too few, we now possess. There may have been some criticism of this, as the popular conception is that the birth of a college tradition is free from the travail and labor unavoidable in the birth of any other idea or concrete thing, that it springs up spontaneously, joyously, from the overbrimming hearts of thousands all attuned to the same beat. This notion is incorrect of course. It is safe to say that no college legend, no matter how spontaneously conceived, sprang from the seed, as from a dragon's tooth, fullgrown. Most of them must likewise pass through that period of uncertainty before there is stamped upon them the approval of the undergraduates as a whole. Nevertheless these things have been and should be no appreciable bar to the growth of those customs which truly reflect the life and spirit of the student-body.

We at Tech realize the paucity of those ceremonies which appeal to the sentiments of the men, we realize that our matter of fact attitude toward such things is only assumed because of lack of opportunity to do otherwise, and at the Junior smoker of last year, when conditions were discussed, the time seemed to be ripe for the inauguration of new ceremonies. It has been proposed that a committee of Seniors and Juniors be appointed to act upon, and if their judgment is favorable, to carry out suggestions which they might originate or which would come to them.

We realize of course that the idea say of foisting upon Tech a half dozen traditions a year, introducing them singly at an interval of so many days with recognized sponsors who should make for them set inaugural speeches, is as ridiculous as would be any other mechanical scheme to carry out such an end. We realize also that if any such movement be not still-born there must be a cause and a call for its coming into existence. We do however, believe that a spontaneous suggestion on the part of one or a group of men should be given full consideration, and, if found to be good, should be granted organized support and encouragement. "The Technology Monthly Engineering Journal" will open its columns to signed suggestions and in all ways possible will do all it can to further this cause. It's up to you.

TWO WORDS OF ADVICE

THE editors of this magazine feel that they are perhaps doing some service in passing on two ideas which have come in from former students. In doing so, rather informally, we beg to say that the advice given here is in no wise intended as criticism, but the subjects are such that they cannot be handled delicately.

In the first place we advise students to take fewer lecture notes in all courses. Graduates estimate that fully two-thirds of the notes taken in lectures at Tech are useless repetitions of standard textbooks. In a lecture on a subject for which some textbook has been written, that text should be carried into the lecture room. The student should listen to the lecture with the text open to the subject under discussion. He should not try to duplicate in his personal notes what is already outlined in the text. We know for a certainty that such a practice is prevalent, and we wish to do what we can to make for conservation of energy.

Secondly, we wish to advise the students to do just the opposite from this after they leave school. In the industries the young college graduate should take copious notes. He should first make a plan drawing—a sketch—of the plant in which he is employed; he should then outline the processes noting specially the quantities of materials used and the machinery used. He should take photographs of these parts of the machinery when too complicated to remember, providing of course that the management is willing. He should make his notes of a personal nature and they should be his private affair. He should consider that he is entrusted with the secrets of the company—and he should be sure that there is no possibility of others seeing his private notes. He may not have occasion to use these notes for years, but they are sure to come in handy some time and it is essential that they be accurate, legible, and complete.

IT seems that there are ever among us those born to unappreciativeness. If Dame Rumor is to be believed this time, we have it that there is a certain amount of abuse to our new buildings being practised daily by some of the students. We have heard of exciting contests wherein the contestants strive to see who can leave the highest mark resulting from a kick, on the wall. As back in the good old days in grammar school the Christmas penknife has found its way into some of the new class room furniture. If the handwriting on the wall is to be interpreted we might conclude that some do not like the interior decoration of the halls and would fain improve it. Those of us addicted to the tobacco habit cannot wait to get into the open to light the soothing weed but must smoke in the corridors, and throw the matches, ashes, and cigarettes about the floors just to prove that said floors are of a fireproof composition and will not burn. And so each day new and unnecessary abuses are brought to our attention.

We are in an educational group built and equipped upon as elaborate and scientific a basis as is possible at the present day. Why should not our buildings and equipment command the respect due to them? It is commendable that the majority do treat them in accordance with the popular idea of the way they should be treated. Are you one of the minority? If so, join the majority.

THIS year the members of the Combined Musical Clubs went as far west as Chicago on the annual trip of the organization. This is the first time since 1911 that the Clubs have made such an extensive tour. The management is to be congratulated upon the securing and booking the engagements and the members are to be congratulated upon having the splendid opportunity to show the Middle West that Tech has other things besides fine new buildings and a stiff curriculum.

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HARVARD ENGINEERING SOCIETY OF NEW YORK

(*Concluded from page* 29)

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At a meeting of the society November 2, Mr. A. A. Cohill, chief engineer of Patrick McGovern & Company, builders of the Dorchester subway tunnel, gave a very interesting talk on the work illustrated by lantern slides and moving pictures.

OPTIMIST

Ida—He said that you were very pretty.

Ethel—He would say so even if he didn't think so.

Ida—I knew he would, and you would think so even if he didn't say so.—Judge.

SOMEWHERE IN FRANCE

"Parlez-vous anglais, m'selle."

"Oui, m'sieur, un peu—Kees me queek—Do you lofe me—'old me tight—dam!"—London Opinion

"How quickly does your machine pick up?"

"Oh, on good nights I have a couple in fifteen minutes."—Gargoyle.

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Bull: How many cigs d'ye smoke a day?

Durham—Any given number.—Jester.

"Why do you think Jones is stupid? He says a clever thing often."

"That's just it,—he should say it only once."—Yale Record.

"How is Alice progressing in her race for a husband?"

"Judging from what I saw through her window, I'd say she's on her last lap."—Yale Record.

She—"You look pale, dearie."

He—"Yes, I just had a close shave."

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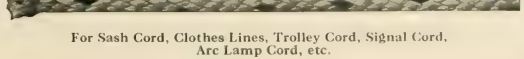

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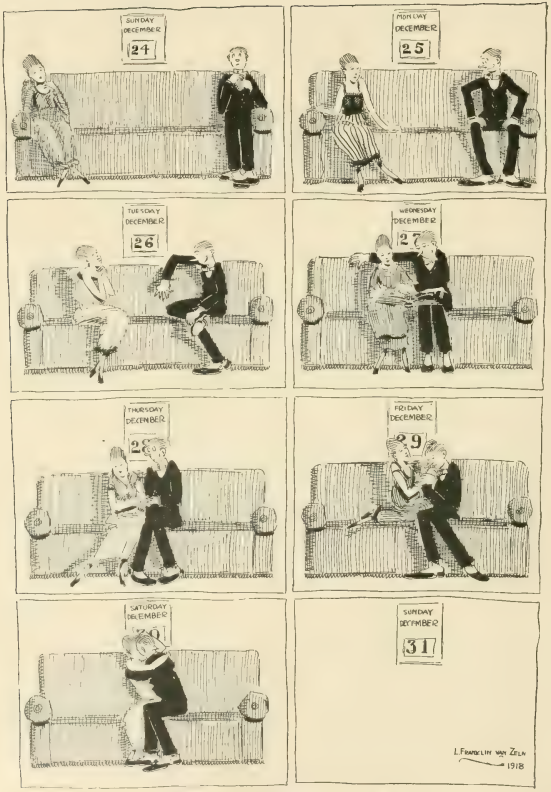

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LAY OVER

Mrs. Hen, having performed her daily task, took a tour around the yard. Returning to the nest, she found it empty and chuckled angrily.

"What's the trouble, madam?" inquired the duck.

"It's darn funny that I can never find things where I lay them."—Awgwan.

A CONCRETE HEAD

Prof.—"Give me a concrete example of a loafing place."

Stewed—"The stone bench on the campus."—Ex.

COME DOWN

He—I could love that girl in green.

She—Oh, don't be so boastful.

—Jack-o'-Lantern.

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ADMIRE THE RING THE OTHER FELLOW GAVE YOUR BEST GIRL
WEAR THAT CUTEST LITTLE XMAS CRAVAT SHE SENT YOU
DANCE WITH YOUR AVOIRDUPOIS COUSIN MERELY FOR THE SAKE OF FAMILY TIES
WATCH THE HANDSOME HEADING MAN MAKE LOVE TO YOUR FIANCÉE
PLAY WITH ROVER 'TIL I BE BACK IN A MOMENT ALBERT
BE LEFT ALONE WITH HER DOG WHICH YOU STOLE BY MISTAKE THE OTHER DAY
THERE WILL BE PLENTY MORE
L.F. VAN ZELM 1918
LEND ANOTHER FIVE WHEN HE HASN'T RETURNED THE LAST FIVE YOU LOANED
TICKLE TICKLE
HANDKERCHIEF
YOU WON'T MIND WAITING A MOMENT DO YOU, LOVEY, WHILE I RUN IN TO SEE MRS. FISH
CARESS AUNT MARY EVERY TIME YOU SEE HER ESPECIALLY WHEN SHE GIVES SUCH MOIST ONES.
CARRY HOME A FEW BUNDLES FOR YOUR NEIGHBOR

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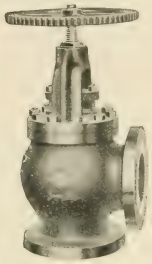

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Prof: William, what is a virgin forest?

Bill: One what's never been axed.—California Pelican.

Miss Modern—Do you suppose that one could catch disease from kisses?

Miss Wise—Well, I caught a husband.—California Pelican.

TWISTED

"I can't understand this code of ethics."

"What code is that?"

"The one which makes it all right to take a man's last dollar, but a breach of etiquette to take his last cigarette."—Louisville Courier-Journal.

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WHAT WILL I FEEL THE FIRST TIME I FLUNK AN EXAM?
I WONDER!
AND I'LL BET I HAVE THIS FEELING WHILE EXAMINING FOR A MID-YEAR EXAM! I WONDER!
DEAN
BOOO HOOO
WHAT OUGHT TO HAPPEN TO THE POST WHO BREAK THE LIGHTS OUT IN FRONT OF THE NEW BUILDING?
I WAS SICK THEN
HOW CAN THE COLLEGE WIN LOW MARKS THIS WEATHER WHEN THEY LOST WEEK AT HOME?
YEA!
WHERE TECHNOLOGY'S FENCE CAME TO END AND WAS SEEN ONLY A FEW EVENINGS A WEEK
AND WE'RE GOING ON OUR TRIP AT MID-YEARS, YES WE ARE!
COMPETITION FOR THE SWIMMING TEAM IS SO CLOSE, CAPT GAY IS HAVING A HARD TIME PICKING THE LAST FOUR MEN TO MAKE THE TRIP. ALL OF SOME TEAM TOO!
THE FAVORITE PLACE FOR MEALS THESE DAYS - AND THERE'S A REASON - OH THESE EATS!!

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CINCH

He is a small-town
Hick, I'll bet;
He talks about the
"Cabaret."
—Luke McLuke.

Another bet
That's pretty safe:
He's always sure to
Call it "kafe."
—Columbia State.

Although his ways
I don't disparage,
I smile to hear
Him call it "garage."
—Detroit Free Press.

A two-bit sport
Is Doolittle Dewey;
He loves to speak
Of his "ennui." —Tapan.

The hotel clerks
Ought not to hoot,
E'en though he asks
Them for a "suite."
-Ex.

The Boston boy
Would pose as seer,
With his oft' spoken
Word "Idear."

And while on high
The pigeons soar,
He says, "I'm going
Up to drawer."

A MYSTERY SOLVED

Husband (a detective)—"Ah, I see you have a new cook, my dear."

Blonde Wife—"How do you know it?"

Husband—"I found a red hair in my soup.—Pit Panther.

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He—Have you got a little spark of love still burning?

She—Yes, dear.

He—Then let's stay in here; it's raining outside.—Brunonian.

Kind Lady—Oh, that man is intoxicated—he looks in real pain.

Happy One—No (hic), madam, not real pain—just champagne.—Froth.

IN THE ROLLER-COASTER

Corpulent Occupant of the Front Seat—"Hey, young feller, would you mind telling me something?"

Y. F.—"Yeah?"

C. O. O. F. S.—"Do you play chess?"

Y. F.—"Yeah!"

C. O. O. F. S.—"Well, move your queen."—Purple Cow.

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WILD BUT TAME

Father—See here, son, I don't want to hear of you being around with that girl any more. She has the reputation of being rather wild.

Son—She's not wild at all father, in fact I can get up quite close to her.—Squib.

Prof.—"What is steam?"

Shark—"It's water gone crazy with the heat."—Lehigh Burr.

"I heard he kissed her in public."

"Did you ever!"

"No."—Jester.

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MY JITNEY

(After R. W. S.)

I haled me a jitney from the street,
  Springless, but, oh, so fair!
I sat me down in the tonneau seat
  And I panted a-sitting there.

I hid all trace of my thoughts unclean;
  I hid the curse in my breast;
I thought how the jitney might have been
  If the Worst had been the Best.

The chauffeur laughed and drove away.
  Then came, with a knowing nod,
A connoisseur, and I heard him say:
  "It's a damn fine car, by God!"

So I painted a halo round his eye,
  And broke all his bones with glee,
And he rests in the graveyard of Saint Hillaire,
  Where you and all may see.

C. N. F.
—Record.

"Did you tell the minister that I did not wish him to kiss me after the ceremony?"

"Yes, my love."

"And what did he say?"

"He said that in that case, he would charge only half the usual fee."—Siren.

DAUGHTERS OF EVE

Miranda wore a charming smile,
  A grace that never failed her,
An air of utter loveliness—
  And that was why they jailed her!

—Yale Record.

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"Jack, you've been making love to some other girl!"

"How do you know?"

"Because you've improved so!"—
—Punch Bowl.

SOME SHAM

He—What would you do if you were a man?

She—Well, what would you do?—Awgwan.

"What is home without a mother?"

"An incubator, I guess."—Cal. Pelican.

He—I worship your very image.

She—Yes, I just saw you kissing my twin sister.—Jester.

BIG HEARTED

"What does your husband do?"

"He's in settlement work."

"Oh, isn't that nice!"

"Yes; he works for a collection agency."—Gargoyle.

1st He—And what did the janitor say when your wife dropped the bag of eggs on his head?

2d He—"Ay tank the yolk's on me."
—Minnehaha.

Minister—Young man, do you know the price of the pursuit of pleasure?"

Blacksheep, Jr.—Yes, sir! Thirty cents the first mile and ten cents for every half mile after that.—Lampoon.

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SINCERITY

He—"My love, honestly, I wonder when God made you how he had anything left for the other angels."

She—"What I love about you, Jack, is that you never flatter."—Judge.

"Gimme a drink of whiskey," laying down coin.

"That's no good here—it's Canadian."

"Waal, then gimme a Canadian whiskey."—Widow.

ONLY A BLUFF

"Your money or I'll throw you off the cliff!" demanded the hold-up man in the wilderness.

The millionaire chuckled and strode on, for he realized it was only a bluff.—Judge.

AFTER THE MIXED DRINKS

He—"I'd like to propose a little toast."

She—"Nothin' doin', kid; I want a regular meal."—Gargoyle.

EVER UPWARD

She—Isn't it dreadful so many things are higher!

He—It all depends. Do you mean prices?—Tiger.

He (returning from the punch bowl)—shall we sit this out?

She (sniffing)—No. Let's walk it off. —Widow.

"Is there an opening here for a bright, energetic young man?"

"Yes; an' close it as you go out."—Judge.

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